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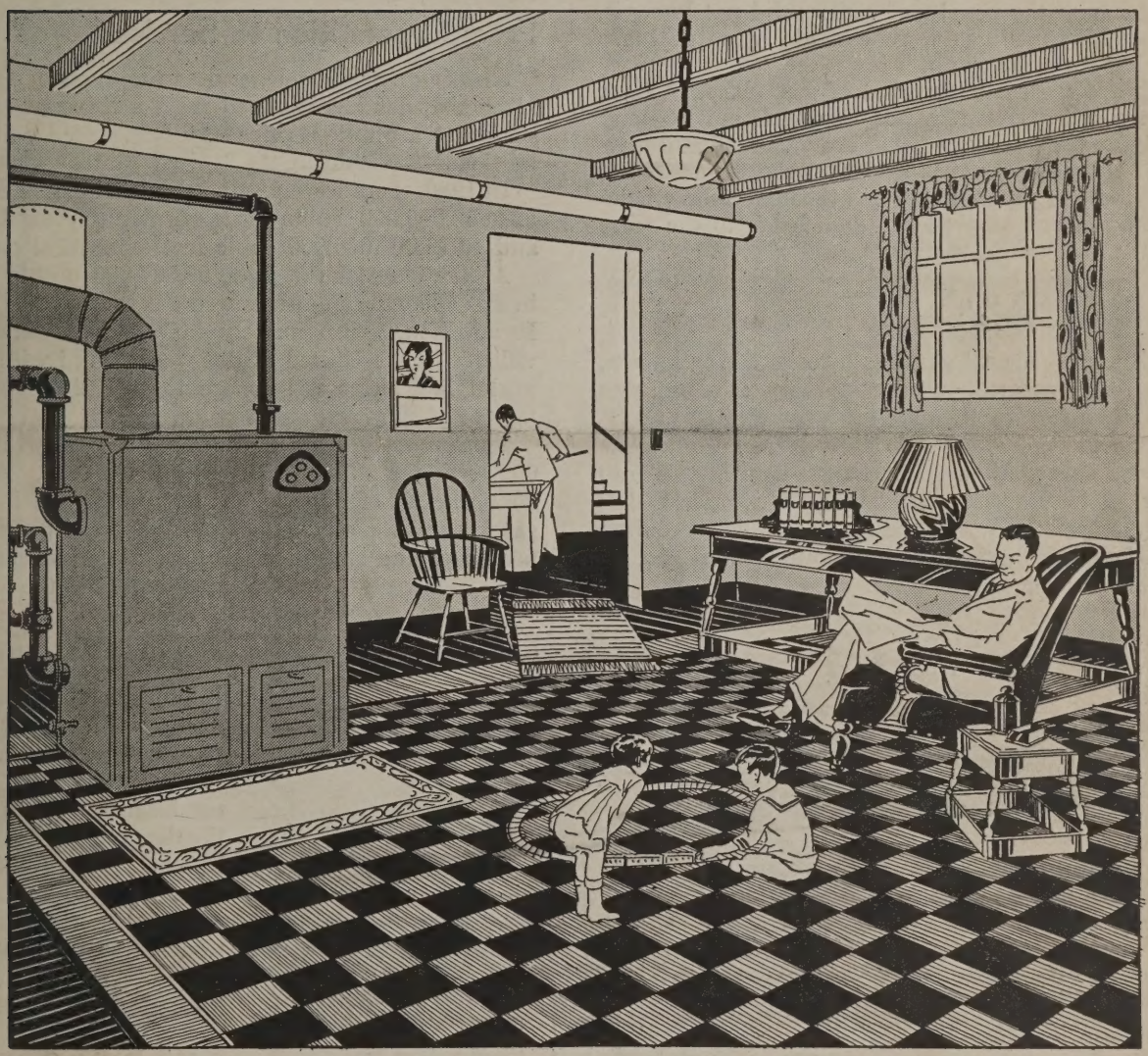
Manufactured and Natural GAS



BASEMENTS ARE OFTEN CONVERTED INTO PLAY ROOMS IN GAS HEATED HOMES. NO SPACE IS REQUIRED IN WHICH TO STORE COAL, AND THERE IS NO DUST OR DIRT WHEN GAS IS BURNED.

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79 West Monroe Street — Chicago, Illinois

GAS—Manufactured and Natural

THREE thousand years ago in Greece, a herdsman noticed that when his goats grazed at a certain place they acted peculiarly. When he and others investigated, they found that they became light-headed and talkative.

This unusual happening was attributed to the supernatural. It was thought that the god, Apollo, was responsible. A temple was erected, and a priestess, acting under the strange influence of the place, uttered prophecies which the people believed.

Thus was the famed Oracle of Delphi established.

Although the people, of course, did not know it, the odd happenings were caused by natural gas seeping from the earth.

This is the earliest record of gas, although later history shows that natural gas was found in many places in the world, and that it frightened and mystified the people. It is said that the Chinese once knew how to pipe natural gas through hollow bamboo pipes, but allowed the knowledge to die more than two thousand years ago.

"A Wild Spirit":

Although natural gas was discovered, or known, long before manufactured gas, its use as a fuel was later than that of the man-made product.

Manufactured gas was discovered by alchemists —those men who tried to change base metals into gold. John Baptist van Helmont of Brussels, Belgium, one of the last of the alchemists, is accredited with being the discoverer of manufactured gas.

About 1609, while experimenting with fuels, he found that they yielded "a wild spirit." This spirit, he discovered, could be produced by combustion, fermentation and by the chemical action of acids on limestone. He wrote that "seventy-two pounds of oak charcoal gave one pound of cinders and the seventy-one pounds remaining served to form the spirit Sylvester. There are bodies which contain this spirit, of which they are almost entirely composed, and is therein fixed and solidified, and are made to leave that state by fermentation as we observed in the fermentation of wine. This spirit, up to the present time unknown, not susceptible of being confined to vessels, nor capable of being produced in a visible body, I call by the name of gas."

So ghost-like and elusive was van Helmont's discovery, that he named it after "geist," the old German word for spirit. So, at its christening, gas was clothed in a mystery that was to obscure it and carry the suggestion of intangibility throughout ages of superstition.

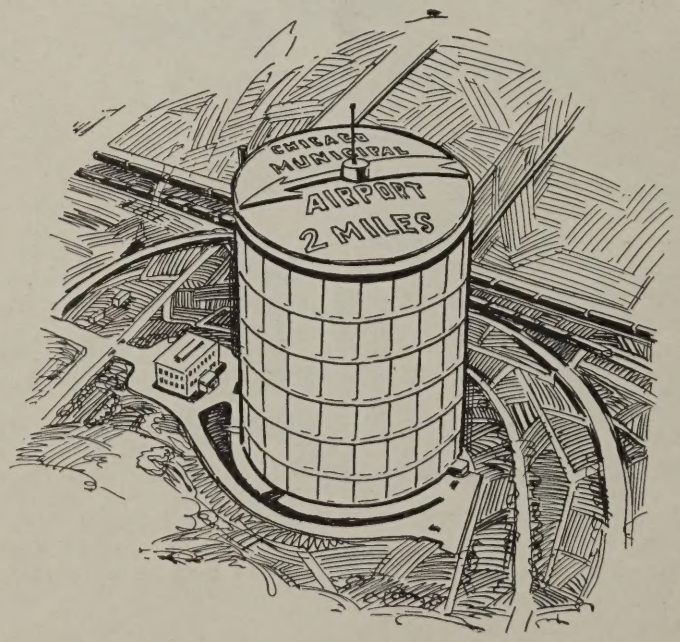
From Superstition to Service:

Starting as an oracle, and as the discovery of an alchemist, gas has changed from a thing of superstition to a public service now being used daily by millions of people in the United States alone.

In 1930, there were produced in the United States 522,853,000,000 cubic feet of manufactured gas, and 1,979,000,000,000 cubic feet of natural gas.

At the close of the year, 59,537,000 people lived in areas having manufactured gas service available. In addition, approximately 4,000 cities, towns and villages in the United States were served with natural gas. There were more than 17,234,000 customers of gas companies.

The people of Illinois, alone, burned 58,073,900,000 cubic feet of manufactured gas in 1930. About 80 per cent of the people lived in areas having gas service available. Manufactured gas companies of the state served 1,364,540 customers at the end of the year.



MODERN WATERLESS GAS HOLDER, MARKED WITH A SIGN TO GUIDE AVIATORS, AND LIGHTED IN ACCORDANCE WITH STANDARDS OF THE U. S. DEPARTMENT OF COMMERCE.

A New Resource:

While small quantities of natural gas have been found in Illinois at various times, they were not large enough to meet the demand for gas, and, before 1931, practically all of the gas burned in Illinois was manufactured from coal and oil.

However, in 1931, pipe lines connecting Illinois with the natural gas fields of the Southwest were completed and natural gas has been added to the fuel supply of the state. These pipe lines rank among the great engineering feats of the age.

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WILLIAM MURDOCK, CALLED "THE FATHER OF THE GAS INDUSTRY," SHOWED HIS FRIENDS A SIMPLE EXPERIMENT IN GAS MAKING IN LONDON IN 1792.

The arrival of natural gas has given gas service to many communities that never had any before. In many communities that had manufactured gas service, the natural gas is being mixed with the manufactured product and the mixture is being burned; in others it is being substituted for manufactured gas and burned "straight" as it comes from the fields; while in some other communities, manufactured gas service remains unchanged.

This Bulletin first tells how manufactured gas is made; secondly, how natural gas is brought to Illinois; and thirdly, how gas—manufactured, natural, or a mixture of the two—is distributed and burned.

Early Development of Manufactured Gas:

Van Helmont was the first to discover gas, but it was many years later when gas was generally used as a fuel.

Dr. John Clayton, a Yorkshire minister, robbed the spirit of some of its elusive qualities by experiments conducted from 1660 to 1670. He found at Wigan, England, what he described as a "shelly coal." Heating this coal in a closed vessel, he found that a "spirit which issued out caught fire at the flame of a candle."

Although Dr. Clayton succeeded in producing van Helmont's "wild spirit" from coal, he, too, failed to turn gas to practical use.

Murdock Father of Industry:

Progress in the development of gas was slow. Civilization had passed through the sperm oil age of lighting to the wax and tallow candle when an unusual man, William Murdock, undertook to produce gas from coal in quantities large enough to permit its use for lighting. Murdock, who is now called "the father of the gas industry," was an associate of James Watt, inventor of the steam engine. Because he wore wooden hats, and often wandered streets at night carrying a lantern made by fixing a tube in the neck of a gas-filled bladder, he was considered eccentric. He was avoided by many people who accused him, and others who experimented with gas, of being in league with Lucifer.

Ignoring the criticism, Murdock succeeded in distilling coal in an iron retort, and in 1792 piped the gas 70 feet through tinned and copper tubes to his home at Redruth, in Cornwall, which he lighted with the "mysterious vapor."

Murdock's regular job was construction and erection engineer for Watt. He devoted his spare time to experiments with gas, which progressed so fast that in 1798 he moved his residence near to the Soho foundry, where Watt, and his associates in the firm of Boulton, Watt & Company, made steam engines. Soon Murdock lighted the foundry with gas.

First Successful Gas Lighting:

As part of the celebration of the Peace of Amiens —the signing of a treaty between Great Britain and France, Spain and Holland—in April, 1802, a public display of the new light was made. It attracted wide attention and comment. Matthews, one of the earliest writers on gas lighting, in describing this spectacle, says:

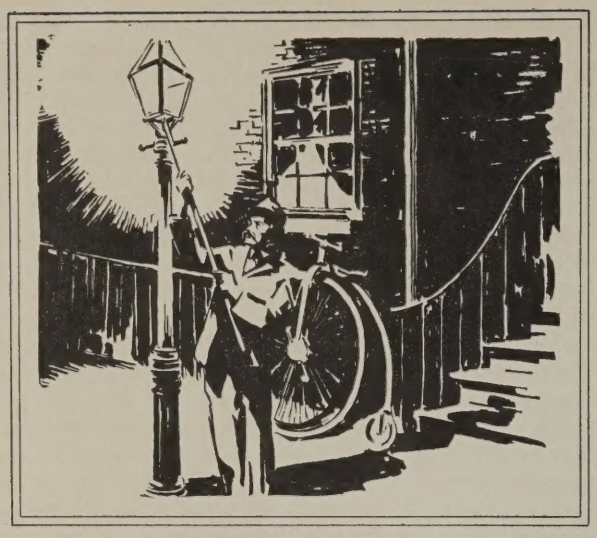
"The illumination of the Soho Works on this occasion was one of extraordinary splendor. The whole front of that extensive range of buildings was ornamented with a great variety of devices that admirably displayed many of the varied forms of which gas light is susceptible. This luminous spectacle was as novel as it was astonishing and Birmingham poured forth in numerous population to gaze at and to admire this wonderful display of the combined effects of science and art."

Murdock was a hard worker and a versatile inventor. He made many important improvements in steam engines, in addition to his development of the use of gas. He introduced the "D" slide valve, which is still used in gas meters as well as in steam engines.

Discovers the Gas Tip:

On one occasion, it is related, Murdock desired to stop the flow of gas, which was burning from an open tube. To accomplish this, he clapped a thimble over the flaming end of the tube. The thimble had been pierced in many places and the gas coming through the holes in smaller volume was brought into contact with a greater proportion of air at the point of combustion. A much better light resulted. This incident was the origin of the gas tip which later came into general use for lighting.

While Murdock progressed in England, Philippe



BEFORE THE INVENTION OF THE ELECTRIC LIGHT, STREETS WERE LIGHTED WITH GAS LAMPS WHICH LAMP-LIGHTERS TURNED ON AT DUSK.

Lebon was the most active and successful contributor in France. Lebon obtained a patent in September, 1799, for making gas by distilling coal or wood and lighted his home and gardens in Paris in 1801.

Other French pioneers were Jean Pierre Minckeler, a professor in the University of Louvain, who demonstrated the burning of gas distilled from coal to his students in 1784, and Lavoisier, discoverer of the composition of air, who invented a gas holder which replaced the bladder, the common receptacle for storing gas before 1781.

The art of gas manufacture took definite form after Murdock had laid the groundwork. Demonstrations by both Murdock and Lebon attracted wide attention and praise from the press and incidentally came to the attention of Frederick Albert Winsor, a German, who played a most prominent part in establishing the first gas company in the world and probably speeding up the general use of gas in homes.

Winsor's Discoveries Important:

Winsor, who seems to have been more of a promoter than a scientific research worker, journeyed from Frankfort to Paris where he witnessed several times "the wondrous effects of common smoke being made to burn with greater brilliancy and beauty than wax or oil." He tried, unsuccessfully, to learn the secret from Lebon. In 1803, at London, he began experiments and demonstrations which led to practical results.

First Patents Obtained:

Winsor, on May 18, 1804, obtained the first English patent for gas-making. He gave a public exhibition by lighting the Lyceum theatre in London with gas. The London Times, six weeks later, printed the following description of the demonstration:

"Sir Joseph Banks, ever indefatigable in examining and promoting useful discoveries, went last Thursday evening, for the second time, with a large party of his noble and scientific friends to the Lyceum to witness the incredible effects of smoke; the whole theatre was lighted with the same, in a novel and pleasing manner; the arch of lights above the stage had a very striking effect, and from the English grate on the stage (which may be fixed in every room) issued a very brilliant and fanciful light. The products of tar, ammonia, and coke were produced and much approved of. Several experiments were made during the course of the lecture, such as boiling a tea kettle and melting ores in a few minutes on a table. It was also proved that a brilliant flame adapted to lighthouses could be formed, which no rain or storm could extinguish. The noble and learned visitors, after a minute examination of the apparatus, stoves and products, expressed the liveliest satisfaction."

Predicts Future Uses:

Winsor had a vision of the future of the gas industry, but he confronted a Herculean task in fighting against old-established customs and prejudices. All of his predictions regarding the utilization of gas came true during the last fifty years. Foreseeing some of its present-day uses, Winsor, in one of his early appeals, said:

"Since the beginning of the world mankind has lost about eighty per cent in all combustibles by the mere evaporation of smoke. This very smoke, which often proves troublesome and dangerous to health and houses, is now discovered to contain the most valuable substances, and if properly extracted, gathered, washed, purified and resolved, we gain no less than five costly products, viz., oil, pitch, acid, coke and gas; which latter product not only furnishes the most intense heat, and the purest light, whenever it is wanted, but can also be applied to supersede the dangerous and expensive steam-engines, because a celebrated French engineer proves that the azote it produces, by a mixture with the atmospheric air, is capable of tenfold power if employed at the freezing point only."

Winsor Ridiculed:

Winsor claimed that gas could be used for heating as well as lighting and that it would result in a three-fourths saving in the construction of buildings because chimneys, stoves and other equipment used in burning other fuels could be eliminated.

"Nay," he remarked in one of his pamphlets, "it will almost appear incredible to assert that the same table, desk or sideboard, which furnishes a light or flame will serve to warm any room and

even dress my victuals in case of need; and, by the mere turning of a cock, or the corking or uncorking of a small pipe or tube."

The enthusiastic manner in which Winsor advanced his subject and his unprecedented claims of the advantages of gas lighting aroused great opposition to his scheme and made him the object of ridicule. Sir Walter Scott, who was much opposed to Winsor's scheme, wrote to a friend, saying: "There is a madman proposing to light London with—what do you think? Why, with smoke."

Napoleon, when he heard of the plan to light London's streets with gas, dismissed the idea as "a big folly." Actors in the music halls poked fun at the tireless inventor and promoter while a writer of humor burlesqued Winsor and his claims in a verse.

Organized First Gas Company:

Despite the opposition and ridicule, Winsor continued his task. He succeeded in getting the support of a large and influential body of shareholders in his company and exhibited the first public street lighting with gas in Pall Mall in London on January 28, 1807. This demonstration did much to remove many doubts regarding the practicability of his discovery.

Winsor sought for his company the exclusive privilege of lighting by gas in all the British possessions, but such a broad charter was refused. In April, 1812, Parliament granted a charter to his company, "The London and Westminster Gas Light & Coke Company," and thus the first gas company in the world came into being.

On December 31, 1813, Westminster Bridge was lighted with gas, and the citizens of London were dumbfounded by the spectacle. It was many years before the citizens of that city became accustomed to gas lighting, although it was extended rapidly after the lighting of the bridge. People thought the flame came through the pipes and many objected when a gas system was installed in the House of Commons. People thought that the "pipes would burn the building" and they were set far away from the walls. The members of Parliament, fearful of being burned, would not touch the pipes with bare hands. Lamplighters at first refused, through fear, to light the new gas lamps, but later crowds followed them to watch their operations every evening.

Samuel Clegg, an associate of Murdock at the Soho Works, contributed to the progress of the industry during this period by building several gas plants. In 1815, he invented the first gas meter and in the following year he constructed the first cylindrical gas holder.

Following its success in London gas lighting spread quickly to other countries. In the United States, Baltimore, in 1816, was the first city to light its streets with gas. In 1820, Paris, France, was so lighted.

Little did van Helmont, working in his laboratory nearly 200 years ago, realize that his discovery would be followed by the manufactured gas industry which, in the United States alone, served a population of 59,537,000 in 1930.

AS MANY AS 5,000 LOAVES OF BREAD ARE BAKED IN ONE HOUR IN BIG, MODERN GAS-FIRED OVENS. THE TEMPERATURE IS AUTOMATICALLY CONTROLLED WITHIN FIVE DEGREES.

First American Gas Company in 1816:

The first recorded demonstration of gas in the United States was in Philadelphia in August, 1796, when gas was manufactured by M. Ambroise & Company, Italian fireworkers and artists. In Richmond, Virginia, a huge gas lamp was erected on a forty foot tower in 1803.

Although there were a few instances of gas being used by individuals in other cities, introduction of gas lights in Rembrandt Peale's museum in Baltimore in 1816 was such a sensation and success that it led to the organization of a gas company and the lighting of the streets of that city with gas.

"Gas Lights without Oil, Tallow, Wick or Smoke" in the "Museum and Gallery of the Fine Arts in Holliday Street" was the way Peale made his announcement in newspaper advertisements on June 13, 1816. An admission fee was charged for viewing this wonderful light and people flocked to see it. The exhibition was so successful that talk of lighting the streets of Baltimore began immediately.

The city council passed an ordinance on June 17, 1816, permitting Peale and others to manufacture gas, lay pipes in the streets and contract with the city for street lighting. Thus the first gas company founded in the United States began to operate in Baltimore in 1816. On February 5, 1817, it was

incorporated as the Gas Light Company of Baltimore.

First Home Lighted With Gas:

A few years earlier, in 1812, David Melville of Newport, Rhode Island, lighted his home and the street in front of it with gas which he manufactured. He also lighted a factory at Pawtucket and influenced the government to use gas at Beaver Tail Light House.

Introduction of gas lighting was slow because it was a radical change from the common methods of lighting in those days. It was regarded with fear by many people and as many objections were made against it in the United States as had been made when introduced in London. A proposal to introduce gas lights in Philadelphia met with strong opposition. In 1830, after gas lighting was used in Baltimore, Boston and New York, Philadelphia still fought against it and "A Public Remonstrance Against Lighting with Gas" was drawn up by prominent citizens who blocked the progress of street illumination until 1836 when the city finally consented to substitute the use of gas for candles, lanterns and whale-oil lamps—the common methods of lighting in those days.

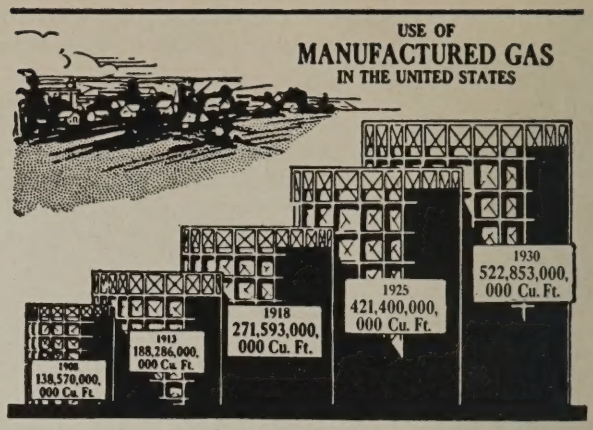
In New England, a proposal to light the streets of one town with gas raised a storm of protest. One paper objected to the proposal on the belief that artificial illumination "is an attempt to interfere with the divine plan of the world which had pre-ordained that it should be dark during the night time." The editor of this paper also put it down as his sober judgment that "lighted streets will incline people to remain late out of doors, thus leading to increase of ailments by colds." He also feared that thieves would be emboldened, and that illumination would rob festive occasions of their charm.

Gas Lighting Spreads:

High rates made gas prohibitive to all but the rich and it was not until 1865 that the use of gas for home lighting began to make any great progress.

Gas was introduced in Chicago on September 4, 1850, the city at that time having a population

THOUSANDS OF MEALS ARE COOKED WITH GAS DAILY IN HOTELS AND RESTAURANTS.



THE PEOPLE OF THE UNITED STATES BURNED 522,853,000,000 CUBIC FEET OF MANUFACTURED GAS IN 1930—NEARLY FOUR TIMES AS MUCH AS IN 1908. ABOUT 68 PER CENT OF THE GAS IS USED IN HOMES.

of only 23,047. Admiring crowds of citizens watched the lighting of the gas street lamps nightly. The state legislature, the year before, had authorized the formation of the Chicago Gas Light & Coke Company. Gas was introduced in Quincy, Rock Island and Springfield, Illinois, in 1854, and in Galena, Ottawa and Peoria in 1855. Its use in other cities of Illinois and the country followed rapidly.

Improvements in Light:

In 1855, Robert Wilhelm von Bunsen invented the blue flame gas burner, which is still in use today in many places. With this burner it is possible to burn gas economically with an intensely hot, but smokeless, flame. It was such an improvement over the burners previously used that it was instrumental in giving a great impetus to the use of gas.

Gas lighting spread and was the common means of home illumination in the cities of the land when Thomas A. Edison invented the electric light in 1879.

Just at the time when the new electric light threatened to take the place of gas lighting, Carl Auer, who studied under Bunsen at Heidelberg, Germany, made a notable discovery for which he was awarded the title of "von Welsbach." He gave to the world the incandescent "Welsbach mantle" which is used today generally wherever gas is used for lighting.

Auer discovered, accidentally, that certain rare earths glow brightly when subjected to the flame of a gas burner. He experimented and found that by coating a cotton webbing with oxides of cerium and thorium he made a mantle covering to surround the gas flame. These substances could be heated to incandescence without losing form or falling apart, producing a much better light than the flat flame or slit-tip burner. Such a mantle produced six times as much light and used less

gas than did the flat flame burner. But, like all other improvements in lighting, progress in the use of gas mantles was slow and they were not used to any great extent until 1890. Inverted gas mantles were not introduced until 1900. In 1896 the Welsbach mantle was applied to street lighting with success.

The gas stove was introduced at the Centennial Exposition, held in Philadelphia, in 1876, when a baking powder company demonstrated the baking of cake with gas. Effort to popularize the use of gas for cooking and heating did not follow until about 1895. Today it is almost universally used for cooking.

How Gas Is Made:

The two most common kinds of manufactured gas in Illinois are: coal gas, made by distilling coal; and carburetted water gas, made by steam from coke and an enriching material—usually naphtha, crude oil or a hydro-carbon. Gas made by these processes is sometimes mixed, since both have the same heating content.

Originally gas was made by distilling coal, this being the method until 1887 when competition caused new processes to be developed. When the chief use for gas was for lighting with open flame burners, gas having a high candle power content was made. Gas engineers invented the carburetted water gas process to increase the lighting content of gas. Later the mantle made possible a larger volume of light with gas of a low candle power.

In manufacturing coal gas, coal is heated in large retorts, or ovens, made of iron, brick or clay. These are kept at a bright red heat for from eight to eighteen hours, the time depending upon the type and size of the oven. As different kinds of coal vary greatly in their chemical composition, there is a wide difference in their value and usefulness for the manufacture of gas.

Upon leaving the retort, gas is about the color of smoke and is very hot. To reduce the temperature—which also reduces the bulk—and to remove impurities, the gas is passed through a series of water-cooled pipes, which rise from a trough partly filled with water. This is the first process of condensation. The gas is not only cooled, but tar and ammoniacal liquid condense and drop to the bottom of the pipes, where the tar sinks to the bottom of the water and the ammoniacal liquid floats on the surface.

The progress of the gas would be hindered and there would be a back-pressure on the retorts unless the gas was helped on its way. Exhausters draw the gas from the condensers and force it to the storage tank.

Scrubbers and Purifiers:

The gas next passes through a scrubber which removes much of the remaining ammonia, sulphureted hydrogen, and other gas impurities. The scrubber is ordinarily a high tower or hollow column containing tiers of boards covered with scrap tin or coarse wood shavings. The gas works its way through these obstructions, depositing tar and other impurities on its way. The gas then goes to the purifiers.

Purifiers consist of closed flat iron boxes filled with wood shavings which have been soaked in a solution of oxide of iron. The gas is passed through several of the boxes. Any sulphureted hydrogen remaining in the gas unites chemically with the oxide of iron to form iron sulphide. When all of the oxide of iron in a box has been changed to iron sulphide, the lid of the box is removed. Exposure to air changes the sulphide of iron back into oxide of iron and the box is ready to be used again.

The gas is now measured by the plant meter and stored in the gas holders, ready for use.

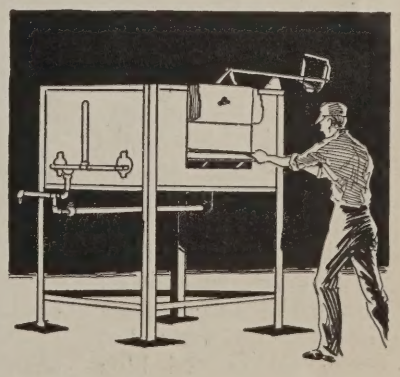
A Simple Experiment:

The making of coal gas can be easily demonstrated by a simple experiment. Place a few small pieces of bituminous (soft) coal in the bowl of an ordinary clay pipe. Seal the opening of the bowl with soft clay. Place the bowl in a hot flame. For a few moments, smoke will issue from the stem of the pipe. When the smoke ceases, apply a match to the stem. There will be a bright flame, showing that coal gas is being produced. A thin, black tarry liquid will ooze from the stem. This contains the innumerable valuable by-products of gas. At the conclusion of the experiment, it will be found that there remains in the bowl a small quantity of "char," or coke.

How Carburetted Water Gas Is Made:

Carburetted water gas is manufactured in three round steel towers—the generator, the carburetter and the superheater.

About three-fourths of the gas is generated, or manufactured, in the generator, which is lined



THE FINEST STEEL IS HEAT-TREATED IN MODERN GAS FURNACES.

with fire brick. The generator is connected with a similarly shaped tower —the carburetter. This is also lined with fire brick, and is almost filled with layers of brick placed criss-cross, thus forming a sort of honeycomb. Like its use in an automobile, the carburetter in a gas plant serves to gasify a liquid —in the gas works, gas-oil is the liquid; in the automobile gasoline is used.

The carburetter is connected to a third steel tower also honeycombed with brick. This is the superheater and is used to complete the work of the carburetter.

The generator is filled with a good quality of coke and the fuel is ignited. Air is blown through the generator until the fuel bed is white hot. The hot gas from the burning fuel in the generator passes through the honeycombs of the carburetter and superheater heating the brick to a cherry-red temperature.

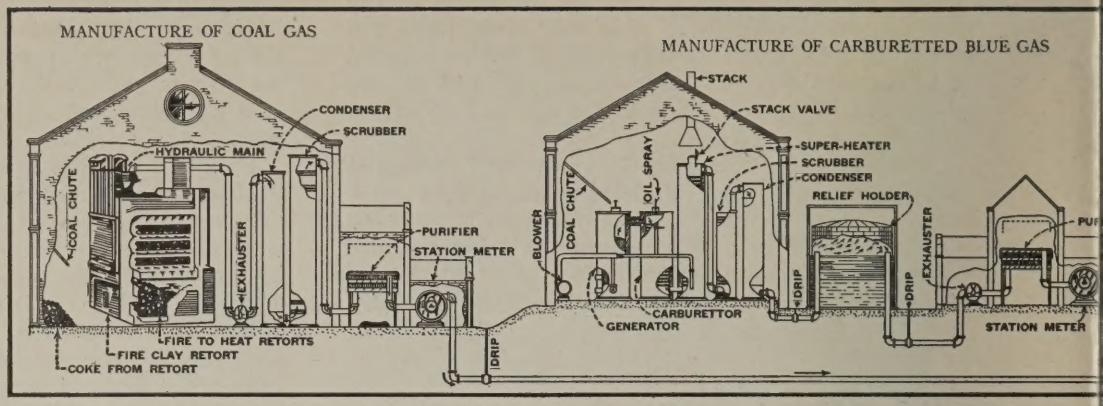
Steam Important Factor:

The air is then shut off, and steam is blown through the generator. The steam reacts chemically with the hot coke in the generator to produce blue gas—a composition of two gases, hydrogen and carbon monoxide—which then passes into the top of the carburetter.

This blue gas has a low heating value and must then be enriched with gas-oil. This is sprayed into the top of the carburetter. As this oil passes through the honeycomb of hot bricks in the carburetter and superheater, it is broken up into gases which have a high heating value. These gases from the oil mix with the gas from the coke to form hot crude carburetted blue gas in the superheater. It is now ready to be purified.

From the superheater the crude gas passes through water in a wash box where some of the tar is removed and the gas is somewhat cooled. As the gas is hot when passing through the water, it picks up a large amount of water vapor which is removed by cooling the gas in the condenser. From the condenser, the gas passes to a relief holder, or

HOW MANUFACTURED GAS



Two different gas manufacturing processes are pictured in the above drawing. One is the manufacture of gas by the distillation of bituminous coal in coking ovens which makes what is known as coal gas. The other makes gas through what is known as the carburetted blue gas process. Coke and steam and usually an enriching material such as oil are used in making gas by this process. All gas companies do not use both processes. A description of both processes will be found on pages 7, 8, and 9.

Following is a brief description of some of the gas-making and distributing equipment pictured above:

CONDENSER

This is fitted with tubes surrounded by water and arranged so gas goes through the tubes and the water absorbs the heat in the passing gas.

SCRUBBER

This consists of a cylindrical tower containing a number of wooden trays having slats running crosswise in checker board fashion and a water spray at the top of the tower keeps the slats wet and washes the impurities down over the wet surface.

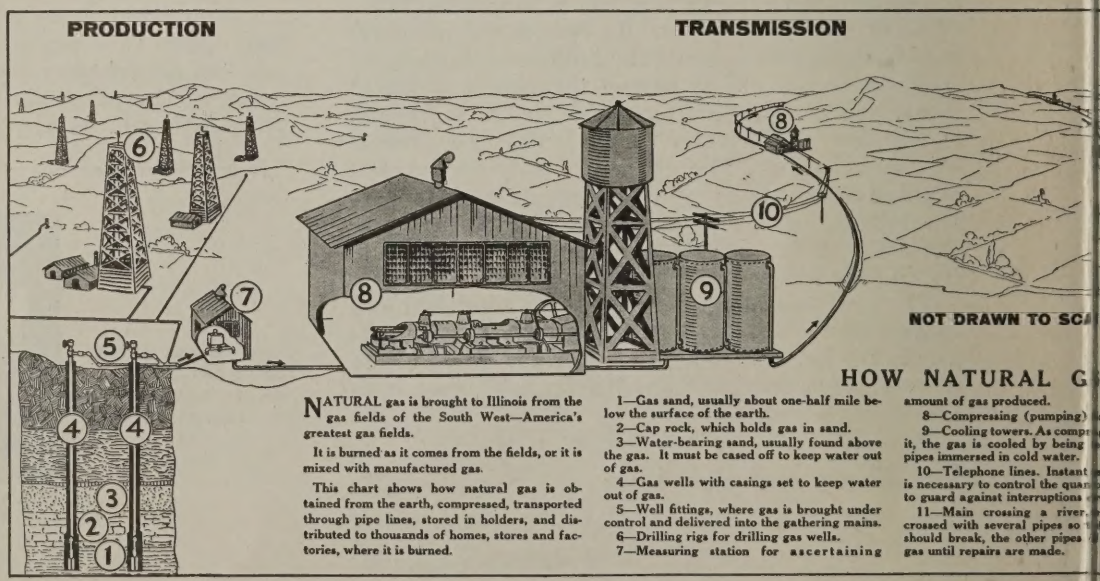
PURIFIER

This is a large box containing two trays of oxide of iron where the sulphur impurities in the gas are absorbed by the iron and removed from the gas. The top or lid of the purifier can be raised, as shown by the dotted lines above, for changing the oxide. A pile of oxide undergoing airing is shown on the floor underneath the purifier.

GAS HOLDER

Two types of gas holders are in common use and

TRANSPORTATION AND DIS



HOW NATURAL G

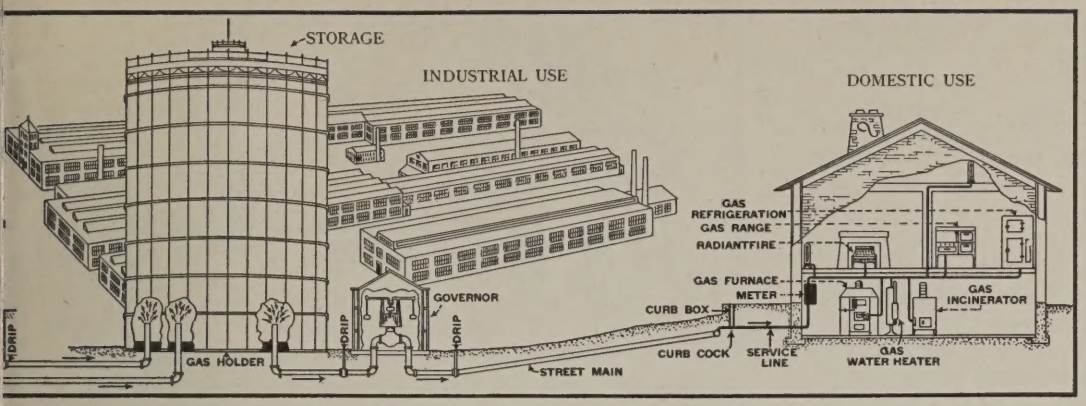
NATURAL gas is brought to Illinois from the gas fields of the South West—America's greatest gas fields.

It is burned as it comes from the fields, or it is mixed with manufactured gas.

This chart shows how natural gas is obtained from the earth, compressed, transported through pipe lines, stored in holders, and distributed to thousands of homes, stores and factories, where it is burned.

1—Gas sand, usually about one-half mile below the surface of the earth.
2—Cap rock, which holds gas in sand.
3—Water-bearing sand, usually found above the gas. It must be cased off to keep water out of gas.
4—Gas wells with casings set to keep water out of gas.
5—Well fittings, where gas is brought under control and delivered into the gathering mains.
6—Drilling rigs for drilling gas wells.
7—Measuring station for ascertaining amount of gas produced.
8—Compressing (pumping)
9—Cooling towers. As compr... it, the gas is cooled by being ... pipes immersed in cold water.
10—Telephone lines. Instant ... is necessary to control the quan... to guard against interruptions ...
11—Main crossing a river. ... crossed with several pipes so ... should break, the other pipes ... gas until repairs are made.

S MADE AND DISTRIBUTED



both types are pictured in the above drawing.

The water type is shown in the "relief holder." It consists of an open top tank or cistern filled with water. A small tank, having an open bottom, is placed in the larger one. Gas is stored in this smaller tank, which rises and falls as the quantity of gas varies. The water acts as a seal to prevent gas escaping.

The waterless type holder, captioned "storage," consists of an upright steel cylinder in which a close fitting piston moves vertically, rising and falling as the quantity of gas beneath it varies.

STATION METER

This is merely a large meter which measures the volume of gas manufactured as it goes to the storage holder.

STORAGE

Gas is made at practically a uniform rate for 24 hours. The rate of use of the gas varies largely during different hours of the day. The function of the holder is to equalize the input and output.

GOVERNOR

To furnish a constant, even pressure to the consumer, the gas goes through a governor which is merely a mechanical device where a variable intake pressure is changed to a practically uniform pressure in the distributing mains.

Governors are located at the holders, in the streets, or just outside the consumers' premises.

DELIVERY OF GAS

From the governor the gas goes into the street mains, through the curb cock, service line, house meter and to the consumer's appliance.

tank, which equalizes the flow of gas through the purifying apparatus.

Carburetted blue gas is purified by scrubbers and purifiers. These are the same as were described in the manufacture of coal gas.

To make the 522,853,000,000 cubic feet of gas produced in the United States in 1930, gas companies used 9,537,000 tons of bituminous (soft) coal, 206,000 tons of anthracite (hard) coal, 3,870,000 tons of coke, and 767,134,000 gallons of oil.

The production of manufactured gas in 1930 was four times as great as that of 1910.

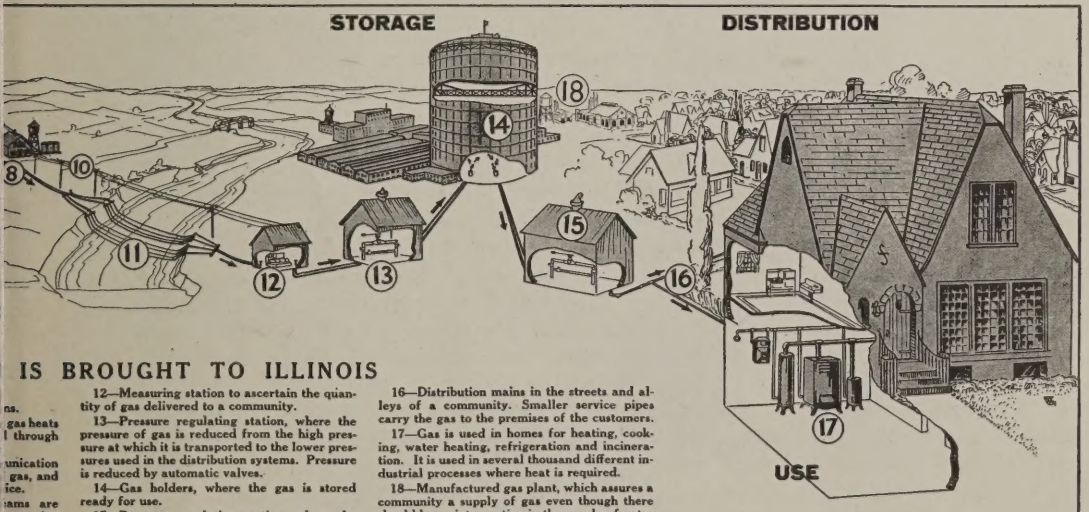
When coal is burned "raw" — in furnaces, boilers, stoves, etc.—only smoke, soot and ashes are obtained as the by-products of combustion. Coal contains, however, other ingredients which are recovered when it is made into gas, and which are valuable as raw products for chemical manufacturing.

From the by-products of gas-making are obtained such widely divergent products as perfume and explosives. Other products include many different drugs, fertilizers, tar, ammonia, dyes, moth balls (naphthalene), photographic chemicals, carbons for electric arcs, coke and saccharin.

In gas-making, one ton of coal will produce about 10,000 to 12,000 cubic feet of gas, 1,500 pounds of coke, 24 pounds of ammonium sulphate, two to three gallons of benzol and nine to twelve gallons of coal tar.

Engineers estimate that of every ton of coal mined in the United States, on an average the heat energy of 1,800 pounds is lost. Less than ten per cent of the bituminous coal mined is "coked," or used in the manufacture of gas.

RIBUTION OF NATURAL GAS



IS BROUGHT TO ILLINOIS

12—Measuring station to ascertain the quantity of gas delivered to a community.

13—Pressure regulating station, where the pressure of gas is reduced from the high pressure at which it is transported to the lower pressures used in the distribution systems. Pressure is reduced by automatic valves.

14—Gas holders, where the gas is stored ready for use.

15—Pressure regulating station, where the pressure is reduced to that at which the gas is burned.

16—Distribution mains in the streets and alleys of a community. Smaller service pipes carry the gas to the premises of the customers.

17—Gas is used in homes for heating, cooking, water heating, refrigeration and incineration. It is used in several thousand different industrial processes where heat is required.

18—Manufactured gas plant, which assures a community a supply of gas even though there should be an interruption in the supply of natural gas. In many communities, a mixture of manufactured and natural gases is burned.

Natural Gas:

Before 1931, practically all of the gas burned in Illinois was manufactured gas—coal gas, carburetted blue gas, or a mixture of the two. Natural gas has been added to the fuel resources of the state by the completion, in 1931, of pipe lines from the gas fields of the Southwest to Illinois.

Three kinds of gas are now being distributed in Illinois. They are manu-

factured gas; "straight" natural gas—that is, as it comes from the fields; and a mixture of manufactured and natural gases. The kind of gas distributed depends upon local conditions.

The Origin of Natural Gas:

Natural gas is a product of Nature. It is "natural" only in the sense that coal and other minerals are "natural." The term is used, chiefly, to distinguish it from manufactured gas.

Scientists say that once North America was a steaming marsh. Great ferns and gigantic trees covered the land. Strange prehistoric animals wallowed in the slime and basked in the sun. As the ages passed, layer upon layer of rotting vegetable and animal matter were formed. Then, after thousands of years, came the last of the earth-shaking volcanic upheavals, burying the animal and vegetable matter hundreds of feet beneath the surface of the earth, and applying tremendous heat and pressure. The layers of vegetable matter were changed into coal by this process, and in the localities that had been centers of animal life, the heat and pressure formed oil and gas in enormous quantities.

Later came the great glaciers of the ice period which smoothed the earth into plains. There was the erosion of rains and streams, and the earth, as it is known in Illinois, gradually came into being.

To the chemistry student, natural gas is a composition of from 75 to 85 per cent Methane (marsh gas), and from 15 to 18 per cent Ethane, with varying amounts of other gases, depending upon the field in which it is found.

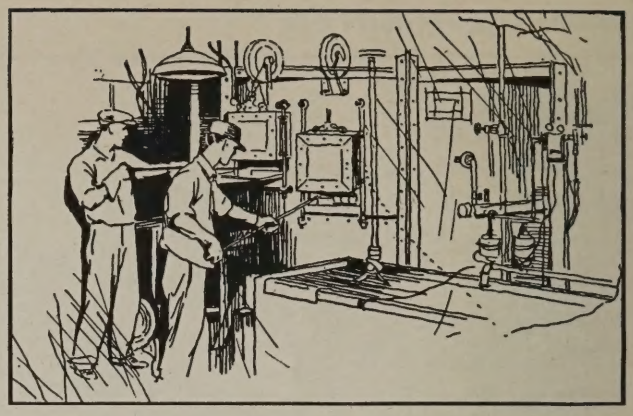
Although natural gas was made by a secret process of Nature, scientists and geologists are unanimous in the opinion that this process ceased many years ago and that the present supplies of natural gas now being discovered are the result of a huge natural storage system.

Liberating Natural Gas:

The gas is found permeating, under great pressure, certain strata of "sand"—really rock—deep in the earth. United States government geological charts help geologists in their selection of sites for wells. These men know that certain forms of sand and shale are almost sure to contain oil or gas.

Natural gas is never found in rooms, caverns or large crevices—it is found in the spaces between the particles of rock composing the "sand." This "sand" is really very porous rock which contains millions upon millions of small, or microscopic, cavities, formed thousands of years ago when the sand and pebbles became cemented together. The "sand" is saturated with natural gas, just as a sponge or cloth is saturated when dripping wet with water.

In places where natural gas has been found, the



TEMPERING STEEL REQUIRES SKILLED WORKMEN AND CLOSELY-CONTROLLED TEMPERATURES. MORE AND MORE GAS IS BEING USED FOR THIS DELICATE PROCESS.

underlying rock, or "shell," forms an arch, sometimes dome-shaped or in a long ridge like a gable roof, over the sand. Gas collected in the sand under the shell just as warm air collects and is held down under a gable roof. Without this shell, gas would sooner or later seep upward out into the air and be lost.

The derricks used in drilling wells to tap these reservoirs resemble the tower of a windmill. Inside the tower is the machinery which forces a heavy drill into the earth, either by twisting it, as an auger is twisted to bore a hole in wood, or by pounding, as a stake is pounded into the ground.

It takes several weeks of steady effort to drill a well. Recently, wells have been driven 10,000 feet—almost two miles—before striking oil and gas.

Often, in spite of the geologist's knowledge and care, the drill strikes a "dry hole"—that is, it does not produce anything.

Drillers know at once when they have struck oil or gas. The force of the gas escaping under tremendous pressure often blows the drilling equipment out of the well and high into the air unless precautions have been taken. Especially constructed valves must be kept ready to cap the well.

A few years after van Helmont made his discovery and while other chemists were trying to discover the secrets of Nature, natural gas was discovered in various places in England.

The earliest description of these finds is in a communication to the Royal Philosophical Society of London in 1667 by Thomas Shirley. He mentions that his attention was directed about eight years before to what was considered to be a spring "where the water did burn like oyle" and "did boyle and heave like water in a pot." On investigation he found this to "arise from a strong breath, as it were, a wind which ignited on the approach of a lighted candle," and "did burn bright and vigorous."

In America, ancient gravel pits near Titusville,

Pennsylvania, and the "burning springs" along some of the streams in West Virginia, are thought by some authorities to show that the American Indian had some knowledge of natural gas and used it, long before the white man came.

In 1775, "pillars of fire in the Ohio Valley" were reported in the chronicles of the French Jesuits.

George Washington's Spring:

It is recorded that George Washington purchased a "strange burning spring" near Charleston, West Virginia, in 1775. It is not recorded, however, that he made any use of his purchase, whose "strangeness" was undoubtedly due to natural gas.

Washington's description of his "natural curiosity" reads: "The tract of which 123 acres is a moiety was taken by General Andrew Lewis and myself for, and on account of, a bituminous spring which it contains, and is nearly as difficult to extinguish."

Natural gas was first used commercially in America at Fredonia, New York, in 1821. This first well attracted little attention, but in 1865 its value was recognized and a company was formed to distribute the gas to the residences of the community. A few years later, in 1872, gas was found at East Liverpool, Ohio, and was burned in kilns of local potteries. It was also piped to Titusville, Pennsylvania, a distance of five miles. This was the first successful "long distance" piping of natural gas.

Later, gas was found in various parts of Pennsylvania, Ohio and Indiana, where its discovery started booms. Much waste attended the use of the "natural" in those days and many "pockets" were exhausted. Small quantities have been found in several places in Illinois at various times, but they were exhausted in a few months or years.

The largest supplies of natural gas yet known have been found in the Southwest. Geologists express their estimates of the available amounts of it in figures that rival those of astronomers. For example, in the Amarillo Field in the Texas Panhandle—one of the most productive fields—it is estimated that there are over 8 million million (or 8,000,000,000,000) cubic feet in reserve.

At first natural gas was an asset only to communities in and near gas fields. In the fields there was more gas than was needed, and much was wasted, while hundreds of miles away there were great population and industrial centers—Illinois for one—that could profitably use the gas if they had it.

The problem was one of transportation, which was solved by engineers who designed and built long distance pipe lines.

Natural gas was piped from Monroe to Baton Rouge, Louisiana, a distance of 170 miles, in 1926. This was the longest line at that time, and was the first of the lines which now make natural gas an asset in many states where it is not supplied by nature.

Practically all of the natural gas used in Illinois comes from the Amarillo Field in the Texas Panhandle. Two lines from this field to Illinois were completed in 1931. One is a line 22 inches in diameter, which crosses the Mississippi River and enters Illinois at Louisiana, in Pike County. It runs northeast across the state, passing through the vicinities of Springfield, Decatur, Champaign-Urbana and Danville.

The Greatest Pipe Line:

The other line, almost 1,000 miles long and the greatest natural gas pipe line development in the United States, enters Illinois near Geneseo and runs east through Joliet, where it connects with the gas distribution system of Metropolitan Chicago and Northern Illinois. This line is 24 inches in diameter and has a maximum daily capacity of 175,000,000 cubic feet.

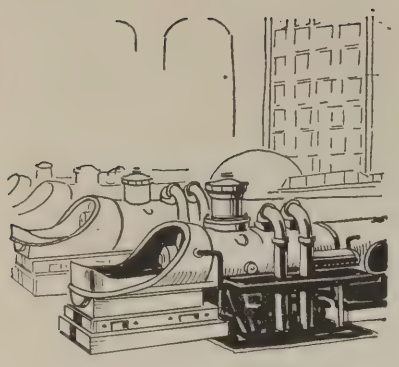
FORESTS, SWAMPS, MOUNTAINS AND RIVERS ARE CROSSED BY LONG-DISTANCE NATURAL GAS PIPE LINES.

The natural gas pipe lines bringing gas from the fields in the Texas Panhandle to Chicago have the capacity to carry more gas than is now needed in the areas they will serve.

The engineers who designed the lines knew, however, that the use of gas in Illinois is constantly increasing and that if the lines were built only large enough for present needs there might be a shortage of gas in the future.

Also, their figures showed them that the cost of building a line does not vary directly as its size, or capacity. In other words, a line to carry double the amount of gas required at once would not cost twice as much to construct, nor would it cost twice as much to operate as a smaller one.

Pipe line building for the transportation and distribution of natural gas was on a larger scale in 1930 than in any previous year, approximately 14,000 miles of line being completed or started during the year. Making the pipe gave work to thousands of employes of steel mills. In addition thousands of persons were employed by gas companies in the field. The shipment of this amount of pipe, in addition to other equipment necessary



HUGE COMPRESSORS KEEP NATURAL GAS MOVING IN THE PIPES.

to building of pipe lines, engines, couplings, fittings, etc., gave the railroads of the country an estimated freight haulage of more than 100,000 carloads.

How Pipe Lines Operate:

In the gas fields, gathering mains carry the gas from the wells to the pipe line. So that the gas will move through the pipes, and so that they will carry more gas, the gas is compressed to pressures that are sometimes as high as 600 or 800 pounds per square inch. (Automobile tires usually have pressures of less than 50 pounds per square inch.)

Compressors resemble big pumps. They receive the gas at comparatively low pressures and squeeze it into a smaller space. Because of its tendency to expand, the gas moves along the pipe line. The first compressor was placed in service at Rexford, Pennsylvania, in 1880. The modern pipe lines, such as serve Illinois, have big compressor stations at approximately each 100 miles.

When pipe lines were built of cast iron pipe, the pressures were limited. Now, steel pipes are used, and, as these can withstand high pressures, a comparatively small pipe will carry a large quantity of gas. Besides the size of the pipe and the pressure which it will withstand, the length of a line and the number of bends or turns in it govern the amount of gas which a line will carry, for friction of gas moving in the pipe reduces its capacity.

PAINT AND CLOTH PROTECT PIPE LINES FROM THE SOIL.

How a Pipe Line Is Built:

While no two pipe lines are the same, and each has certain difficulties of construction which must be overcome, in general, all lines are alike in basic principles.

First, the route of a pipe line must be selected. As often rivers, swamps and mountains intervene between a gas field and the territory for which the gas is destined, it is important that the route have as few hazards as possible. As pipe lines are expensive to build and operate, it is also important that the route be as short as possible. At the same time, the route should be accessible, so that the pipe itself may be delivered, and so that the line may be inspected and maintained after it is completed.

After the route is determined upon, it is necessary to secure the right-of-way. For a long line, this means negotiations with several hundred, and perhaps thousand, owners of the land which will be crossed by the pipe line.

WELDING MAKES TIGHT JOINTS ON PIPE LINES.

Where the terrain permits, the trenches in which the pipe is laid are dug with big ditching machines. Special construction is required, however, through swamps, over mountains and through rocks. It is often necessary to use dynamite to blast the ditches.

How Streams Are Crossed:

Streams are crossed with several pipes, so that should one pipe break, the other pipes can carry the gas until repairs are made. As the pipe lines are buoyant, heavy weights are attached to them, so that they will remain on the bottom of the streams.

There are two methods of coupling the pipes together. The most common method is welding with a very hot flame; the other is by the use of clamps and rubber gaskets.

Before the pipe is placed in the trenches and

covered with earth, it is coated to protect it from rust, and from the harmful chemicals that are in all soils. The pipe is painted with asphalt, wrapped with cloth, and painted a second time.

Large pipe lines have their own telephone systems, connecting the wells, compressor stations and communities that use the gas. Instant communication is necessary to control the quantity of gas, and to guard against interruptions in service. Telephone service is also available to the inspectors who patrol the lines constantly.

Distribution:

The long-distance pipe lines transport the gas from the gas fields to the communities where it is burned. In these communities are distribution systems which are not designed for the high pressures of the pipe lines, and the pressure of the gas must be reduced. This is accomplished by special valves, which are entirely automatic in operation.

After the pressure is reduced, the gas flows into big holders, or tanks, where it is stored ready for use.

Uses of Natural Gas:

Besides being used for fuel, natural gas is the basis for about 30 different commercial products.

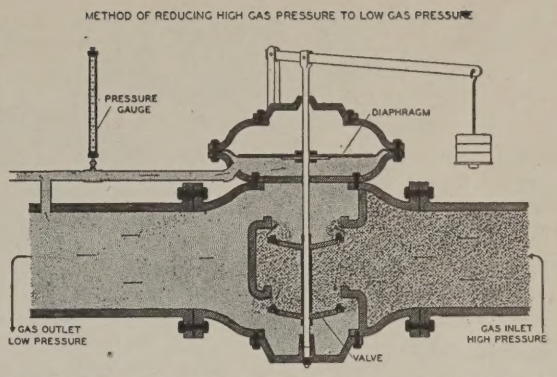
In 1874, Edwin C. Bell found that gasoline could be removed from natural gas by compression, but it was not until 1903 that this discovery was put to a commercial use. Natural gas is now classified as "wet" and "dry." Gas is dry when less than one gallon of gasoline is recovered from 1,000 cubic feet of gas.

Natural gas is used to make carbon black, an essential product in the manufacture of automobile tires and other rubber articles, carbon paper, phonograph records, cement colorings, stove polishes, printing inks and insulating materials. Carbon black is made by directing a gas flame against a metal surface, the reverse side of which is cooled by water. The burner is adjusted for imperfect combustion, and the carbon black is deposited on the metal as a soot.

Other products made from natural gas are alcohol, ammonia, bakelite, methyl orange, carbon dioxide, benzine and chloroform.

Helium, a non-inflammable, lighter-than-air gas, used by the United States government in its dirigible airships, is obtained from natural gas. It is recovered in the gas fields by reducing the temperature of the gas to 300 degrees Fahrenheit below zero. At this point all the other constituents of natural gas become liquid and helium of up to 80 per cent purity is drawn off to be further purified by another freezing process.

In most of these processes the gas is consumed; while in some others only non-combustible constituents are removed, the combustible parts being used as fuel.



GAS IS PIPED FOR LONG DISTANCES AT HIGH PRESSURES. BEFORE IT IS BURNED, THE PRESSURE IS REDUCED BY SPECIAL VALVES, OR GOVERNORS, WHICH ARE AUTOMATIC IN THEIR OPERATION.

Production of Natural Gas:

Figures show that in 1930 most of the natural gas was used in the fields where it was produced. Production totalled 1,941,000,000,000 cubic feet. Of this, 37 per cent was used in the fields for drilling additional oil and gas wells; 14 per cent for the production of carbon black; 5 per cent as fuel in petroleum refineries; and 6 per cent as fuel in electric generating stations. Only 16 per cent of the production was used as fuel in homes, although there were 5,100,000 homes burning natural gas.

Distribution of Gas:

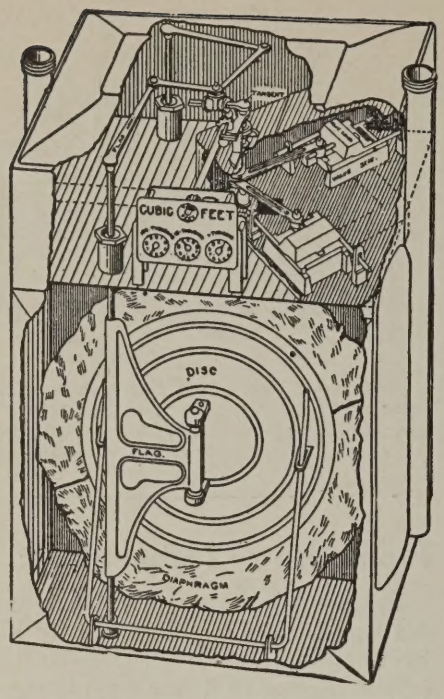
After manufactured gas is made, and after natural gas reaches the communities where it is to be distributed, it is stored in big holders, or tanks.

Storage and distribution to customers is the same for manufactured gas, "straight" natural gas, and for a mixture of the two.

Holders are of two types—the water-sealed type; and the newer, waterless holder. In principle, the water-sealed type is an upright metal cylinder with its upper end closed and the lower, open end immersed in a tank of water. As the quantity of gas in the cylinder varies, the cylinder falls and rises in the water. The water prevents the gas from escaping. The waterless type consists of an upright metal cylinder which is stationary. It contains a piston which rises and falls as the quantity of gas in the holder varies.

The largest holder in the world is in Chicago. It is of the waterless type and has a capacity of 20,000,000 cubic feet.

Because these giant gas holders are often the most conspicuous structures in a community, they are now being marked and illuminated as guides for aviators. Recently the Aeronautics Branch of the United States Department of Commerce report-



METERS MEASURE THE VOLUME OF GAS USED BY CUSTOMERS. ALTHOUGH OLD IN DESIGN AND SIMPLE IN PRINCIPLE, THE GAS METER IS ONE OF THE MOST ACCURATE DEVICES USED TO MEASURE ANY COMMODITY.

ed that because of their size, gas holders stand out even in times of poor visibility.

The holders of several Illinois gas companies show on their tops the name of the town, the direction and distance to the nearest field, and north. Red lights warn night flyers away, and the tops are floodlighted after dusk.

Gas from the holders is distributed to homes, stores and factories through pipes laid in the streets and alleys of a community. Smaller pipes—called service pipes—lead from the mains into the premises of the customers.

The laying, maintaining, and inspecting of these pipe lines without unnecessary disturbance of city streets is an important and difficult task. The men who maintain them must be on constant duty. Their vigilance never ceases. Like an operation on the human body, repair work must be done while the system continues to function.

Manufactured gas companies of the United States had 112,100 miles of mains in service at the close of 1930—not including the service pipes. Illinois ranks second of the states in miles of gas mains, there being 11,336 miles in the state.

Gas in Rural Areas:

Once a convenience had only in large cities, gas service is now available in many small Illinois towns and villages which are too small to support their own gas-making plants. This is a development of the last few years, and one that is stimulated by the arrival of natural gas.

The first successful attempt of this kind was in Illinois in 1902 when an experimental line was constructed from Aurora to Geneva, serving Batavia on the way—the first city in the world to which mains were extended to furnish gas for cooking in territories widely separated from the point of production.

This wide-spread distribution of gas service is made economically possible by compressing the gas at high pressures, thus enabling a comparatively small pipe to carry a large quantity of gas. The pressure is reduced before the gas is delivered to customers.

Adjacent gas distribution systems in Illinois are rapidly being inter-connected—that is, neighboring companies are joining their pipe systems together. Should the supply of gas fail in one area, an adjacent system could furnish a supply until service was restored. This inter-connection, therefore, tends to assure a supply of gas at all times.

How Gas Is Measured:

Before the invention of the incandescent electric lamp, when gas was used almost exclusively for lighting, its quality was judged by its candlepower. When electric lights became common, and gas was used chiefly for heating, the quality was judged by the number of heat units in a cubic foot.

The heat unit used in measuring the quality of gas is a Btu (British thermal unit). A Btu is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

More recently, a number of gas companies, including some in Illinois, have adopted the plan of showing on gas bills the number of Btu a customer uses in a month, instead of only the number of cubic feet burned. For convenience in billing, the number of Btu is counted in Therms—one Therm equalling 100,000 Btu.

Natural gas contains almost twice as many Btu per cubic foot as does manufactured gas.

The Gas Meter:

Before the invention of the gas meter, the quantity and cost of the gas delivered to a customer were estimated by the size of the burners and the number of hours they were used. Inspectors were employed to make the rounds of the various districts at certain hours every night to see that the lights were extinguished at the proper time.

When the light was seen burning after the designated hour in any home, the inspector notified the user by a loud rap at the door—the signal for a general extinguishment. When these warnings were not heeded, the inspector closed a valve in the service pipes outside of the house.

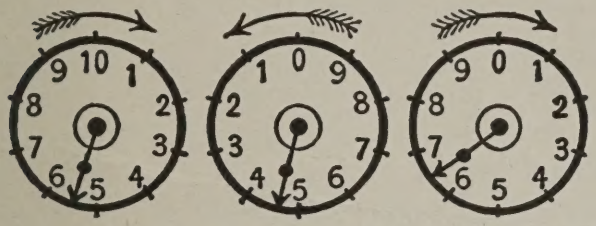
The idea of selling the gas by measurement originated with Samuel Clegg, who invented the first meter in 1815. The type of meter now in use was invented by William Richards in 1844. It is so simple that no substantial improvement has been made upon it since it was invented, and it is one

of the most accurate devices used to measure any commodity.

Gas is measured in a meter by two bellows. While one is being filled with gas from the mains in the street, the other is being emptied, the gas flowing to appliances in use by the customer. When one bellows is filled and the other emptied, the cycle commences again. This continuous process of each bellows being alternately filled and emptied causes a simple mechanism to revolve the hands on the dials, and thus indicate the quantity of gas that has passed through the meter. The meter does not operate except when gas is being used by the customer.

How to Read a Gas Meter:

Anyone can easily learn to read a gas meter and check the amount of gas used through it each month. Suppose the hands of the dials are pointed like this:



Reading from left to right, take the smaller of the two figures next to the hand on each dial. On the dials shown above, these are 546. Then add two ciphers to these figures (in this case it is 54,600) and from the figures thus obtained subtract the meter reading of the previous month as shown on the last gas bill. The result is the number of cubic feet of gas used during the month.

As the number of Btu in a cubic foot of gas is known, it is a simple problem in arithmetic to determine from the readings of the meter the number of Therms burned.

The Gas Burner:

Gas alone will not burn. It must be mixed with air for combustion to take place. The purpose of a gas burner is to mix together air and gas in the correct proportions, and to carry this mixture to the place where the flame is wanted.

An incorrect mixture wastes gas. The flame should be blue, and almost invisible. The flame on a gas stove should just touch the bottom of the cooking vessel. If the flame comes up the sides of a kettle or skillet, gas is being wasted.

Uses for Gas:

In homes gas is used for cooking, heating, water heating, burning garbage (incineration), drying laundry, refrigeration and sometimes for lighting. More gas is used for these household purposes than in any other way. Of all of the gas made in 1930, homes used 68 per cent, and of all of the gas that was piped away from natural gas fields, 50 per cent was used by household customers.

Each year gas is being used more and more for househeating. It is smokeless and clean, requires no attention, and the temperature of a home is easily controlled within a degree or two. At the close of 1930, in Illinois there were 27 per cent more homes using gas for househeating than there were at the close of 1929.

One of the earliest uses of gas for heating homes was reported in The British Journal of Gas Lighting, of April 22, 1873, by a John Barber, who had been to Denmark and "visited a Dane's home several times before being aware it was heated by gas, although the day was very cold and the room warm." He reported that "the Dane had no dirt, ashes, coals, or other lumber to provide for or to remove and he succeeded in obtaining a heating power which can be increased or diminished at will, to suit the requirements of the day."

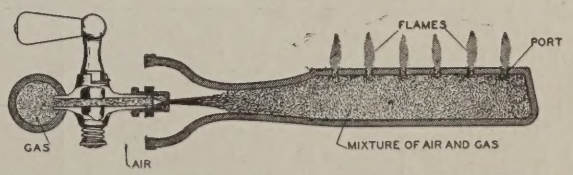
While seemingly a paradox, gas-fired refrigerators are successful and in daily use. Peculiarly, the hotter the gas flame, the colder is the refrigerator. At the present time, gas-operated refrigeration is used chiefly for cooling foods, but engineers say that in the near future large installations will cool the better class American homes in summer, just as many of them are now heated in winter.

Gas in Industry:

Great use of gas in industrial processes has been developed in the last ten years. It is estimated that there are at least 20,000 different uses for gas in industry, and some businesses are now dependent upon gas for their existence.

Because it is clean and the temperature may be controlled easily and accurately, gas is used extensively in such industries as textiles, ceramics, steel and non-ferrous metals. In metallurgical processes, varying from tempering a watch spring to forging parts for automobiles, gas is acclaimed the ideal fuel. It is used to melt aluminum and brass; in the making of battery plates; in stereotyping; electrotyping; annealing; vitreous enameling; and myriad other manufacturing processes.

TYPICAL GAS RANGE BURNER ASSEMBLY
ILLUSTRATING
FLOW OF AIR AND GAS



FOR PROPER COMBUSTION, GAS BURNERS REQUIRE A MIXTURE OF GAS AND AIR—MORE AIR THAN GAS. THE BURNERS CONTROL THE AMOUNT OF AIR AND GAS USED IN THE MIXTURE, AND ARE ADJUSTABLE.

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Although most people are familiar with gas for cooking in homes, few realize the extent to which it is used by restaurants, hotels and other businesses which cook foods in large quantities. They use it for roasting, broiling, frying, grilling, boiling and baking. It is used by bakers and by manufacturers of potato chips, crackers, pretzels, candy, canned foods and breakfast foods. It is used to roast coffee, nuts and spices.

Recently, some Illinois railroads have placed gas burners underneath the track switches in their switch-yards and terminals. When a snow or sleet storm occurs, the burners are lighted. They melt the snow or sleet, and the trains run without delay.

Other common industrial uses for gas are making steam for laundries, welding metals, drying lumber, pressing clothes, forging, heating rivets, galvanizing, cutting metal, tool dressing, bolt and rivet making, flanging and bending pipe, treating steel structural materials for fabrication, soft metal melting, silver and aluminum refining, etc.

Gas a "Natural Monopoly":

The gas business is called a "natural monopoly" because good and economical service is best assured by having only one gas company in a given territory. But this is the only sense in which the business is a "monopoly." It has no "monopoly" on the purposes for which it is used. Especially since gas has come to be used mostly for producing heat, it has to compete with all other heat-producing fuels.

In other days some of the larger cities had two or more competing companies but experience proved the fallacy of the plan. Existence of more than one company to supply any utility service in a given territory means economic waste and duplication of investment, plants, offices, employes and general expense. Economic law has generally forced competing gas companies to consolidate.

All of Chicago, for example, is today served by The Peoples Gas Light and Coke Company, which is a consolidation of fifteen other gas companies. This company was incorporated under a special act of the state legislature, February 12, 1855, and was the second oldest of the combined gas companies. It acquired all competing companies by authority of an act of the legislature passed in 1897.

Owners of Gas Companies:

Gas companies and other utilities, such as electric light and power, telephone and street railway companies, are nearly always incorporated businesses, usually with a large number of stockholders. The companies and their property are owned by the stockholders, of whom there are often thousands in a single company—thrifty investors who have bought into the company with their savings. It is estimated that there are upwards of 3,000,000 of these individual public utility security holders in the United States.

The stockholders elect directors (commonly called boards of directors) who are primarily responsible for the management of the companies. The directors elect and supervise the company officers who attend to the details of management.

Regulated by State:

These companies are regulated by state commissions in virtually all of the states of the Union. In Illinois the regulatory body is the Illinois Commerce Commission, which is part of the state government. The commission has supervisory authority over the rates, the service, the financing (issuance of stocks and bonds) and the accounting (bookkeeping) of the companies.

Under the system of regulation by the state, gas companies and other utilities are permitted to earn only a fair return on the value of the property used, or usable, in their business. Rates are adjusted upward or downward (subject to approval by the regulatory commission) as conditions vary, so as to permit the gas companies to earn operating expenses and a fair interest return on the capital investment.

THE GAS INDUSTRY

	1920	1925	1930
Manufactured Gas in U. S.			
Sales in Cubic Feet	319,888,000,000	421,400,000,000	522,853,000,000
*Population served	45,997,000	52,000,000	59,537,000
*Number of customers	8,837,000	10,600,000	12,134,000
*Miles of mains	68,500	86,800	112,100
*Number of employes	71,000	85,800	90,800
Total operating revenue	$345,000,000	$465,000,000	$537,469,000
Natural Gas in U. S.			
Consumption in Cubic Feet	798,210,000,000	1,188,571,000,000	1,979,000,000,000
*Number of customers	2,615,000	3,508,000	5,100,000
Manufactured Gas in Illinois			
Sales in Cubic Feet		46,786,452,000	58,073,900,000
*Population served			5,881,000
*Number of customers		1,254,077	1,364,500
*Miles of mains		9,129	11,336

*As of December 31.